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Analysis of the opportunities and challenges for renewable energy market in the Western Balkan countries

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A B S T R A C T

Western Balkan (WB) countries have the highest energy intensities in Europe, i.e. much more energy is used for the production of a unit of work here than in any European country. Nonetheless, very little investment and priority are being given to the increase of the efficiency. On the other hand, the Western Balkan countries have a high potential for developing energy production from renewable energy sources (RES): water, wind, biomass, and geothermal energy. However, these potentials are not studied and exploited enough and the present situation for their utilization is not so good. Although energy is a critical foundation for economic growth and social progress of all the WB countries, there are many constraints for RES development in all of them (political, technological, financial, legislative, educational, etc.). Obviously, defining development strategies and new support measures is necessary since renewable energy sources can make an important contribution to the regional energy supply and security. The main purpose of this paper is to explore the renewable energy market (opportunities) in the Western Balkan region.

Contents

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1. Introduction – energy sector description in the Western Balkan countries

"Western Balkans" is a new (artificial) name for a group of countries located in the Central and Western part of the Balkan Peninsula, created as a consequence of the political and geo-strategic changes during the last twenty years. Western Balkans region has a total area of 264,552 km^2 and a population of approximately 23 million inhabitants [1]. Excluding Albania, it is composed of the ex-Yugoslav Republics, now independent states, i.e. the Federation of Bosnia and Herzegovina, the Republic of Croatia, the Former Yugoslav Republic of Macedonia, the Republic of Serbia, and the Republic of Montenegro [2] (see Fig. 1).

It is a region full of diversities, similarities, common things and particularities, crossroad of different nations and civilizations, battlefield of three big religions. It is a homeland of many nations living together, but at the same time divided in different countries, with artificial borders composed by the invaders or big forces, depending on the influencing strategic interests.

Western Balkans region is a large energy consumer per unit of GDP [1]. The consumption before the 1990s had been similar, but the import dependency was smaller and differently structured. Import included mainly liquid fuels and almost no electricity and coal [2–6]. Gradual stabilization of the economy or its improvement emphasizes the fact that high energy consumption, largely dependent on import, can have a negative influence on the future development of the region [7]. Most of the production plants are old-fashioned and need reconstruction and improvement of the production efficiency. Also, the main energy resource is coal, which has rather strong negative impact on the environment. Altogether, the sector needs sound investments in order to follow the accepted strategies for development and incorporation of the systems in the common EU zone.

Energy import/export is a rather complex issue for the Western Balkans region, if taking into account the present changes and efforts to establish a "common" energy market. It is quite easy to determine concrete figures for the electricity trade, probably for the liquid fuels as well (but not for oil derivatives). On the other hand, coal trade is a bit more difficult to predict (different qualities in different industries, for various uses), and it is definitely complicated to forecast the trade with the bioenergy resources, circulating between the countries in official and unofficial ways.



Fig. 1. Map of Western Balkan countries.

2. Current status of the renewable energy development

International experts have now categorized renewable energies in two categories, i.e. traditional and new renewable energy sources [8]. Anyhow, renewable energies market is in direct correlation with the accepted and implemented legal, financial and organizational measures that support their introduction into different economy sectors.

For all of the Western Balkan countries it can be summarized that:

- Partial engagements for defining the concrete strategies for development are present. None of the countries has a concrete strategy for particular RES development that is officially accepted and supported by measures that would enable its implementation;
- None of the countries have developed a suitable legal background allowing easy access to permissions, concessions, funds, etc., enabling application of RES;
- None of the counties have defined sufficient and sustainable programs and solutions for particular measures for supporting development of concrete RES;
- Only some of the countries (i.e. Croatia) have allocated funds for supporting the development of RES.

Last but not least, none of the countries have enough data and information essential for the determination of the market for particular RES at their disposal. This should be one of the most important directions of the future engagements in RES development, if the desired level of development is to be achieved.

2.1. Laws, regulations and policy – legal background

Legal background varies from one country to another, but does not enable the creation of sufficiently favourable conditions for RES development in none of them.

2.1.1. Albania

In general, renewable energy data for Albania is limited. Presently, there have been no regulatory incentives identified for the development of renewable energy projects. Albania lacks legislation in the field of renewable energy sources, as well as energy conservation. However, the Albanian Government has indicated awareness of this situation and is preparing an Energy Law, as well as an Energy Efficiency Law [9]. Government Decree No. 424/June 2003 approves the National Energy Strategy until 2015 [10]. According to this decree, the Ministry of Industry and Energy and the National Agency for Energy are appointed to update this strategy every two years. Energy Policy Law has a special focus on promoting the energy efficiency and energy conservation, creating an Energy Efficiency Fund, energy efficiency labeling, and promoting energy audit schemes. Environmental Protection Law No. 7664/January 1993 [11] provides environmental impact assessment and protection schemes in Albania. This Environmental Protection Law completely revises the environmental protection schemes and measures practiced in the country until recently.

According to this Law, the control over the sources and causes of pollution shall be exercised by the Ministry of Health and the National Environmental Agency (NEA), upon the request of any of the parties affected.

2.1.2. Croatia

The Croatian energy legislation ("package" of energy laws), although generally affirmative regarding the use of renewable energy sources, has not been completely implemented after a few years of application, i.e. at the level of secondary regulation [12]. Some vital issues for RES, like incentives or even institutional arrangements, have been left weakly regulated or even undefined. During last years, development of national legislations environment for renewable energy sources is adopted in accordance with the European framework regarding the use of renewable energy sources within the EU.

Legal treatment of RES and cogeneration in Croatia has only started a few years ago. Due to the generally high production costs of energy from RES and cogeneration, and due to the existence of so called incremental cost, the legislator envisaged introduction of financial support to RES and cogeneration. At the same time, supply companies are obliged by law to use certain portion of renewable and cogeneration in the energy mix they are selling. The law obliges the Government of Croatia to define the share by the *Decree on minimum share of RES and Cogeneration*. The role of an intermediary between renewable producers and supply companies is given to a recently established independent market operator. The market operator is responsible for contracting with renewable generators on one hand, remunerating them at price determined by the law, and, on the other hand, with suppliers, ensuring that they fulfil their legal obligation. Additionally, the market operator, which is under the control of the Croatian Energy Regulatory Agency [5], will also be responsible for "accounting, collection and distribution of financial assets coming from special fees for promotion of RES and cogeneration". In this way the incremental cost of renewables and cogeneration will be passed on to final consumers in the most efficient way. The foreseen support scheme is intended to be operational only for the quantity of renewables and cogeneration prescribed by the Croatian Government. The law prescribes that the Government will determine the minimum share of RES and cogeneration, but not the pace of implementation [13]. The draft *Decree on minimum share of RES* proposed a linear annual increase of RES generation starting from 2006 by approx. 150 MW/yr until 2010. Regarding the heat, the Law on Production, Distribution and Supply of heat regulates in a systematic and comprehensive manner all activities related to production, distribution and supply of heat, including the rights and obligations of energy subjects (heat producers), the rights and obligations of customers, the measures to provide financial means for building up plants and facilities for production, distribution and supply of heat, and others.

Besides the regulated tariffs for RES and cogeneration (fixed price or feed-in) and minimum share obligation, there is another strong instrument for promoting the RES in Croatia. It is the Environmental protection and energy efficiency Fund, established by a special law in 2003 [14]. The aim of the Fund is to ensure additional financial sources for projects and programs in the field of protection, sustainable use and improvement of the environment. Furthermore, the Fund takes part in financing projects, programs and measures (including National Energy Programs) aiming to increase energy efficiency and use of renewable energy sources. Public authorities of the Fund are authorized to adopt administrative acts referring to introduction of fees and special fees, define the conditions that have to be fulfilled by the Fund beneficiaries, as well as to define the conditions and criteria for selection of projects and programs to be financed from the Fund. The Fund should act as the main source of investment subsidies for off-grid and individual thermal applications in the field of RES in Croatia.

Result of the legal document *Effect Decree on Management and Protection of Coastal Region* (Official Gazette No. 128/04) [15] is the prohibition of the construction of wind farms in the coastal region.

2.1.3. Bosnia and Herzegovina

The definition of renewable energy within the Bosnian regulations governing electricity differs from the EU directive on the promotion of electricity from renewable energy sources in the internal electricity market [2]. Furthermore, the sections on "national indicative targets" and "guarantee of origin of electricity produced from renewable energy sources" stated in the EU directive are not taken into account in the regulation adopted by BH. Discussions are therefore in process to produce an in-feed directive that would be standard for the whole of BH and in conformance with the EU policy.

In 2002, the Government adopted a resolution to promote the generation of electricity from renewable energy sources. In this, the electricity suppliers or grid operators are obliged to accept electricity from renewable energy sources in their grids and to pay a fixed rate for it. The level of remunerations for the in-feed of electricity from renewable energy sources with a maximum installed capacity of 5 MW is coupled to the amount of the medium-voltage tariff.

In the spring of 2004, the South East European Enterprise Development (SEED) Program of the International Finance Corporation (IFC) launched a program to promote renewable energy through certificate trading [16]. The goal of the SEED program is to support companies and institutions in BH to switch to renewable energy sources thereby reducing GHG emissions.

2.1.4. The Republic of Macedonia

There is no particular law related to RES development or use in the Republic of Macedonia. The Law on Concession Rights partially covers the geothermal and water resources use rights, but inefficiently. There is only an obligation for confirmation of the tariff of geothermal heat sold to third parties, but not successfully implemented. Small hydro power plants are in a similar situation.

Some of the main strategic objectives of the Government of Republic of Macedonia include the stimulation of the investments in the renewable energies development, as well as the bigger inclusion of renewable energy sources (RES) in the energy consumption and the increase of the energy efficiency. Certainly, for a successful implementation of such measures by the Republic of Macedonia, as a candidate country and future member of the European Union, constant work on harmonization to the European Law is necessary. Particularly in the area of energy efficiency and RES that must represent a legal frame for improving all further measures within these energy areas. According to the statistic data [17], 50% of the energy supply is based on the domestic fossil fuel and hydropower and 50% on the import of gas, liquid fuel and coal. Gross energy demand in RM is approximately 120,000 TJ based on the electricity consumption and electricity import with insufficient use of RES capacities of the country.

Republic of Macedonia has favourable opportunities for utilization of RES, such as: hydro-energy, geothermal energy, solar energy, biomass and wind energy. As stimulative measures for investments in the RES, preferential tariffs for buying and selling electric energy produced by small hydroelectric power plants, wind, photovoltaic and biogas power plants are being brought.

Republic of Macedonia follows actively the acts brought by the European Union in the RES area and at the same time prepares the national legislation harmonized with the EU regulations. The Ministry of Economy of the Republic of Macedonia [18] is the institution responsible for the preparation of energy legislation in RM (The Energy Law (Official Gazette, No. 65, 2007), Strategy for the usage

of RES, Strategy for energy efficiency). The Energy Agency of the Republic of Macedonia (EARM) [19] supports the implementation of the Government energy policy by preparing energy strategies, developing plans and programs, with a special accent on the use of renewable energy sources (RES) and energy efficiency (EE). The EARM has a mandate to lead, give initiatives and coordinate the preparation of studies and projects for RES and EE, to mediate and support potential investors as producers of energy from RES. The aim of all this is a successful accomplishment of the action plans for realization of the energy strategies of RM. The Ministry of Environment and Physical Planning of the Republic of Macedonia [20] adopts the National Strategy for the first period of obligations according to the Kyoto Protocol 2008–2012. The National Strategy adopts the regulations and procedures for implementation of projects in accordance to this mechanism. It gives an overview of the carbon finance potential in many areas, such as: energy sector (RES and EE sub-sectors, rehabilitation of large hydroelectric power plants and fuel replacement), waste sector (municipal and industrial waste as well as the waste from the agricultural and forestry sectors) as well as the forestry sector itself (biomass).

2.1.5. Serbia

By signing the Treaty establishing the Energy Community of Southeast Europe and EU in 2006, Serbia has accepted the obligation to apply directives related to the increased use of renewable energy sources (2001/77/EC and 2003/30/EC) [3]. Application area of renewable energy is governed by the Republic of Serbia legislative framework in the field of new and renewable energy sources (RES). The strategy for development defines priority directions, and renewable sources are in the third place. Creation of Energy Development Strategy of the Republic of Serbia until 2015 and program implementation for achieving that strategy is given greater importance to the RES. By ratifying the Treaty establishing the Energy Community (Treaty between the EU and SEE countries) on 14th of July 2006 the Republic of Serbia has accepted *inter alia* the obligation of implementation of directives aimed at the increase of the use of RES. Such are the *Directive 2001/77/ES on the promotion of electricity from renewable energy sources in the internal electricity market* and the *Directive 2003/30/ES on the promotion of the use of biofuels or other renewable fuels for transport*. This implies that the Republic of Serbia is obliged to make a plan for the implementation of these directives [21]. With the Energy Development Strategy of the Republic of Serbia until 2015, within the framework of selective use of renewable energy sources, it is particularly pointed out that there are special benefits and the need for organized use of RES in Serbia, in the so-called decentralized production of heat (biomass burning, and “collecting” solar radiation) and electric energy (the construction of small, mini and micro hydropower plants and wind turbines up to 10 MW). All this in order to satisfy local consumer needs and to supply surplus electricity to local electricity network in the system of Serbia. New renewable energy in Strategy until 2015 was predicted to reach 200,000 ten and to enter the energy balance sheet of Serbia. Hydropower is the only RES utilized for electricity generation and registered in the official Serbian Energy Balance [6]. During the research conducted in the course of the development program in the field of RES 2007–2012 for each of the selected RES (sun, wind, biomass, geothermal energy, waste, etc.) the state of existing infrastructure has been analyzed. Number of built facilities for the exploitation of RES in the Republic of Serbia and their current annual energy production is insignificant. Capital invested in the facilities infrastructure built so far is low and mostly of domestic origin. From the national level stand point of view, the financial results achieved form current facilities for the use of RES are very small. Technical and technological characteristics of equipment that is located in the facilities for the exploitation of RES constructed so far are of poorer quality compared to the equipment used in the EU today. The equipment is mainly of domestic (less foreign) origin, and of older production date. Level and quality of the organization are well below EU. Major problems are: reliability, safety production, energy efficiency and maintenance of these facilities.

Serbia is specifically suitable for use of the geothermal energy and biomass as renewable sources of energy. Government and all other state level institutions have put the production of energy from RES as the top priority, and there is a special law which regulates adequate subsidies and privileged investment status for the investors in this sector [22].

Generally speaking, exploiting the RES energy is insufficient, and therefore existing potentials are absolutely unused. In order to improve the overall situation, Serbian authorities have taken a whole set of measures and activities in order to increase the production of energy from RES, based on domestic and foreign investments. Serbia has all the basic potentials for producing energy from RES, but estimates point out the fact that Serbia has the most favourable conditions for the use of geothermal sources, wind, and biomass [6].

2.1.6. Montenegro

Energy sector in Montenegro is recognized as an important driving force of the national economy, which can be followed in the Energy Development Strategy of Montenegro until 2025 (2007) (EDS) and Action Plan 2008–2012 [23]. Five-year Action Plan for the Energy Development Strategy of Montenegro assumes that Montenegro will start using its high energy potential. Montenegro started implementing programs and projects aimed at improving utilization of renewable energy sources, with the most important being: measuring potentials for construction of sHPP, construction of sHPP, measuring wind potentials and construction of wind generators. Ministry for Economic Development of Montenegro, together with the national and international partners, started the project “the Year of Energy Efficiency”. The Project “Year of Energy Efficiency” is the product with specific activities presented in: the Action plan for implementation of the Energy Efficiency Strategy 2008–2012 and the Action plan for implementation of the Energy Development Strategy of Montenegro by 2025, for the period 2008–2012 [23,24].

2.2. Economic feasibility of application

It is very difficult to give a general answer about the economic feasibility of the application of any of the renewable energy sources used as capacities for heat generation or for electricity generation [25]. The final price of heat and electricity includes many components, some of which are very much dependent on the local situation and particular usage. According to the gained experience and calculations made, the regional prices do not differ very much from the world and European average.

In any case, as at the world level, the production and distribution system for any of the RES is not sufficiently developed to compete to the energy produced from the fossil fuels, nuclear plants or large hydro power plants, mainly because the negative impact on the environment of the latter ones (in very different forms) is normally not included in the cost of the energy production and supply.

Nowadays, at least in the developed countries, the situation is gradually changing (e.g. “green” funds). However, this is still not the case in the Western Balkans region, although some first steps of such orientation can be followed [26].

2.3. Constrains to the RES development

Most of the Western Balkan countries accept the defined responsibilities for reaching EC level and have already undertaken the

activities for removing the present constraints in line to develop the usage of RES. However, they are still far behind the EC level and it is difficult to expect that they shall be able to fulfil their engagements on time [27]. Far more active approach and very strong priority to these actions are necessary to reach a real change of the present situation.

Some of constrains for the RES development are:

- Absence of treatment of RES as energy resources with potential to seriously influence the national, regional or local energy balance;
- Absence of consistent development strategies;
- Absence of the necessary legal background;
- Absence of defined convenient system of funding the development;
- Absence of defined convenient economy environment for investing in RES development;
- Absence of developed system for information dissemination;
- Absence or very low level of education on RES investigation, development and exploitation.

2.4. Need for development

Need for development of RES comes from the dependency of all the Western Balkan countries on energy imports (fossil fuels, natural gas, and electricity). On the other hand, most of the countries have quite high or very high energy intensity per unit of GDP and high energy imports, which make them sensible to the fluctuation of prices of liquid fuels, gas and electricity at the international market. Increase of participation of indigenous energy resources in the national energy balances can ameliorate the present negative situation.

2.5. Possibilities for development of RES

The possibilities for development of RES are quite limited due to the present treatment of the RES in most of the Western Balkan countries. In all of the countries RES development is accepted as a high priority for the country and approached in a strategic and active manner. Defining the necessary measures and instruments for their implementation in accordance to the European experience, as well as the strong endorsement of the defined EU goals, plan for sustainable energy Europe and plan for energy efficiency Europe [28] is in process. All the activities are mostly initiated and financed by EC funds, USAID, World Bank and other international programs, which make them rather limited and, thus, have small influence on the general situation in the countries in question. As mentioned above, without creation of attractive economic conditions for RES development, significant advance cannot be expected [5,13,27].

2.6. Analysis of potential, present share and prospects for the utilization of RES for heat and electricity

Potential, present share and prospects for the utilization of RES for heat and electricity according to [28–32] in WBCs are as follows:

Hydro appears to be the most promising resource for renewable energy project development. Albania [29] is known for its enormous hydropower potential (Table 1). There is however, a concern to increase reliability in dry years when hydropower output is significantly reduced. Privatization seems to be the main driver behind small hydro rehabilitation and development.

Albania belongs to the sub-tropical belt zone as well as the Mediterranean climatic zone. Overall, the country has a hot, dry summer and a relatively short and mild winter. Although Albania is in a somewhat favourable climate for solar development, it does not seem likely that there will be an emphasis on solar development in the near future (Table 1).

Table 1
Analysis of potential, present share and prospects for the utilization of RES for heat and electricity – Albania.

Type of RES	Potential	Present share	Prospects
Heat			
Solar	Significant	Limited	Excellent
Biomass	Significant	Significant	Good
Geothermal	Limited	n/a	Poor
CHP	Significant	Poor	Good
Electricity			
Hydro	Significant	Significant	Excellent
Biomass	Limited	Poor	Excellent
Wind	Limited	Poor	Poor
CHP	Significant	Poor	Good

Table 2
Analysis of potential, present share and prospects for the utilization of RES for heat and electricity – Bosnia and Herzegovina.

Type of RES	Potential	Present share	Prospects
Heat			
Solar	Limited	Poor	Good
Biomass	Significant	Good	Excellent
Geothermal	Limited	Poor	Good
CHP	Good	Poor	Good
Electricity			
Hydro	Significant	Significant	Excellent
Biomass	Limited	n/a	Poor
Wind	Limited	Poor	Good
CHP	Good	Poor	Good

There are many thermal springs and wells in Albania, which represent a potential for geothermal energy in Albania, but there are no known high enthalpy locations identified for electricity production.

There are no operational wind energy power plants in Albania. However, Albania does have developable wind potential. Not sufficient wind data is available to estimate the technical potential of wind energy but initial engagements are being taken, even the low electricity rates seem to hinder the economical development.

Incentives and interest in biomass renewable energy projects seem low at this point, although a significant technical potential has been identified (17.5 TWh/yr thermal), perhaps enough for 600 MW of power generating capacity [30]. However, biomass energy could be important in Albania's future, consisting of the following four main resources: urban waste, agricultural residues, forest residues, and animal waste.

With regard to solar irradiation, Bosnia and Herzegovina is among the more favourable locations in Europe with solar irradiation figures of 1240 $kWh/m^2/yr$ in the north of the country and up to 1600 $kWh/m^2/yr$ in the south. There is a great potential for Bosnia and Herzegovina to combine the two energies in establishing a unique central system from biomass heating plants and solar systems (Table 2).

Bosnia and Herzegovina has a great potential of biomass, as the energy output is estimated at approximately 1 million m^3 per year.

As many of the cities currently use combustion of crude oil for heating, serious damage to the environment could be avoided by introducing the geothermal heating.

On one hand, Bosnia and Herzegovina has a huge potential of 2500 GWh for small hydro power plants (Table 2). On the other hand, the potential of large hydro power plants is impressive and there are big plans for the construction of several large HPPs. However, large HPPs cannot be categorized as "renewable" due to the fact that they have serious negative environmental and social impacts, increase vulnerability to climate change and significantly crowd out funding for other renewable sources.

In Bosnia and Herzegovina there have been no renewable energy projects financed by the IFIs.

Table 3
Analysis of potential, present share and prospects for the utilization of RES for heat and electricity – Croatia.

Type of RES	Potential	Present share	Prospects
Heat			
Biomass	Significant	Good	Good
Solar	Significant	Poor	Good
Geothermal	Significant	Poor	Good
Electricity			
Wind	Significant	Poor	Good
Biomass CHP	Significant	Poor	Excellent
Geothermal	Limited	Poor	Good
Small hydro	Significant	Poor	Good
Solar PV	Significant	Poor	Poor

In Croatia (Table 3), the total potential energy capacity of small hydro sources is 177 MW.

In 2001, bio-energy accounted for 3.3% of the total energy supply of Croatia and the total energy potential of biomass is 39 PJ.

Several studies indicate that the Croatian islands and the Adriatic coast are good locations for wind energy. According to the ENWIND National Energy Program the total energy potential of wind is 209 MW on the islands, while it is 163 MW on the Adriatic coast.

According to the SUNEN National Energy Program the total energy potential of solar energy is 100 PJ.

Croatia has geothermal reservoirs in the northern part of the country, characterized by a high value geothermal gradients. In 2000, the total installed capacity was 36.7 MWt and the total potential is estimated at 839 MWt (Table 3).

On the territory of the Republic of Macedonia (Table 4) there is a significant potential of geothermal energy, treated as inexhaustible source of energy all over the world [31]. Average temperature of geothermal water in geothermal baths on the territory of Kocani, Strumica, Gevgelija, Debar, Kratovo, Kumanovo and Katlanovo is between 30° and 78° and is mostly used for greenhouse heating at this moment. However, geothermal water sources are underused with the average annual production of 210 GWh, and their role of thermal consumption in the energy balance is less than 0.5%. The greenhouse sector has a great potential thanks to the favourable climatic conditions and the opportunity to use renewable energy sources for heating, which include geothermal energy too.

There are more than 400 potential small hydro sites with small hydro plants from 45 kW up to 5000 kW. Therefore the overall potential is 225 MW in capacity and 1100 GWh in terms of the annual energy production.

There are no wind turbines for energy production installed in Macedonia. However, the potential for energy production by using wind power is estimated to be favourable, especially in the central part of the country.

Table 4
Analysis of potential, present share and prospects for the utilization of RES for heat and electricity – Macedonia.

Type of RES	Potential	Present share	Prospects
Heat			
Solar	Significant	Poor	Good
Biomass	Significant	Significant	Good
Geothermal	Significant	Limited	Excellent
CHP	Good	Poor	Good
Electricity			
Solar	Significant	Poor	Excellent
Hydro	Significant	Significant	Excellent
Biomass	Good	Poor	Poor
Wind	Not investigated	n/a	Good
CHP	Significant	Poor	Good

Table 5
Analysis of potential, present share and prospects for the utilization of RES for heat and electricity – Serbia.

Type of RES	Potential	Present share	Prospects
Heat			
Solar	Significant	Limited	Good
Biomass	Significant	Good	Good
Geothermal	Significant	Limited	Excellent
Electricity			
Hydro	Significant	Limited	Excellent
Biomass	Significant	Poor	Good
Wind	Good	Poor	Good
CHP	Significant	Poor	Good
Geothermal	Good	Poor	Good

The technical potential of biomass (energy resource from forests, agricultural residues and municipal waste) is estimated at 3361 GWh. Biomass has many advantages to other energy sources, especially to the fossil fuels, which come obvious from the following: less pollution from combustion, annual renewal (agro-biomass), growth (forest biomass), comparatively easy accessibility, equal geographical disposition, utilization opportunities of substances that contaminate the environment as well as its attractive price.

As one of the sunniest countries in the region, Macedonia has an annual solar energy value of 10 GWh (Table 4).

In Macedonia, in 1999 the World Bank initiated the preparation of the programme on small hydro plants through the Mini Hydro Power Plant project. Together with the GEF (the Global Environmental Facility) the WB provided funds for the co-financing of 5 small HPPs with a capacity of 1.37 MW and electricity production of 11,000 MWh. From 2007, GEF provided funds for the co-financing of the installed capacities in Macedonia based of RES.

In average wind speed zones (Table 5), Serbia has a wind capacity (onshore and offshore) of 26.3 TWh/yr.

28,000 solar thermal units have replaced the equivalent of 0.14 TWh of fossil fuels. The total potential for solar active technologies is approximately 50–60% of the heating demand in the central regions.

In Serbia (Table 5), there are more than 60 geothermal systems with temperatures lower than 150 °C. The estimated energy reserves of geothermal resources are around 800 MWh.

It has been estimated that 200 ktoe of the conventional transport fuel could be saved each year through methanol production from crops grown only on 3% of the total arable land. And another 260 ktoe/yr is considered available from agricultural wastes but few applications exist at the present time.

Serbia has 39 small hydro power plants with the installed capacity of 49 MW. There are 856 potential sites for small hydro power plants with a capacity of up to 10 MW.

In Serbia, there have been no renewable energy projects financed by IFIs [28].

Table 6
Analysis of potential, present share and prospects for the utilization of RES for heat and electricity – Montenegro.

Type of RES	Potential	Present share	Prospects
Heat			
Solar	Significant	Limited	Excellent
Biomass	Significant	Good	Good
Geothermal	Poor	No use	Poor
Electricity			
Hydro	Significant	Limited	Excellent
Biomass	Significant	Poor	Good
Wind	Poor	Poor	Poor
CHP	Significant	Poor	Good

Montenegro (Table 6) currently has no operating or planned wind installations [32]. Montenegro has great biomass energy potential. Potentially available wood quantity in forest fund of the Republic of Montenegro is assessed to 2.6 m^3/ha/yr. Current rate of utilization of wood from the forest fund amounts to approximately 1 m^3/ha/yr. Based on the assessed biomass potential from forests and wood industry, preliminary economic analysis is made for three biomass power plants of 2 MW, 5 MW and 10 MW.

As in the case of other countries in the area, solar levels in Montenegro are among the highest in Europe. The most favourable areas record a large number of hours of sunlight, with the yearly ratio of actual irradiation to the total possible irradiation reaching approximately 50%. The monthly distribution is particularly important in determining utilization for heating; and whether back-up systems will be needed during periods of extended cloudiness. Montenegro has a medium temperature geothermal resource throughout the greater part of the country and currently has approximately 680 MW of hydroelectric capacity. In Montenegro, there have been no renewable energy projects financed by IFIs.

2.7. Similarity among the countries

The identification of the best options for wide introduction of RES in the Western Balkan countries shows a high level of similarity in all the countries:

- Biomass heat plants, geothermal energy and solar thermal collectors for heat production;
- Small hydro power plants, wind farms (especially Croatia) and biomass cogeneration for electricity
- generation;
- Liquid biofuels for transport.

Other RES technologies, like solar PV for electric energy generation and geothermal cogeneration can also make valuable, but limited contributions in some countries in the short- and middle-term.

The Western Balkan countries have a great potential of RES, but the existing situation for their utilization is not so good. There are many constraints for RES development (political, technological, financial, legislative, educational, etc.) and new supportive measures are necessary.

3. Proposed strategy for RES development

In all WBC the lack of state RES strategies compatible to the European legislation and appropriate programs for the RES implementation is probably the main barrier for all RES. A “National strategy for RES development” is necessary in order to reflect the importance of RES development, to specify the future goals, including the share of RES in energy balance, and to demonstrate its benefits for both the users of these energy resources and the country as a whole. The strategy must encourage the energy production from renewable energy sources where economically justified and environmentally acceptable, by providing the framework for the creation of appropriate supportive measures.

In addition, it should be very useful to compose a common regional strategy for RES development, which should enable composition of sufficiently big development market for foreign investors and local industries development.

3.1. Legislative measures

The existing legislation and regulations in many WBC do not help RES at all. Complicated procedures for providing the necessary documentation for the use of the RES have often been a reason for investors to abandon RES projects.

All the countries have Energy Laws, similar to those in the EU, developed to modernize the structure of the energy sector, promote RES, to break up the current monopolies and to open the sector to competition. For completion of the legal framework for RES it is important to adopt:

- Decree on the minimum share of RES and cogeneration;
- Regulation on RES and cogeneration utilization;
- Regulation on fees for electric energy generation from fossil fuels;
- Tariff system for electricity production from RES and cogeneration;
- Regulation on the criteria for acquiring the status of eligible producer;
- Grid code and other regulations from the transmission and distribution domain;
- Sub-acts stipulated by the Law on Production, Distribution and Supply of Heat.

After this RES legislative framework has been created it is necessary to prepare and implement corresponding secondary regulations and sub-acts that are comparable with the EU practice and are easily implemented. The goal of this legislation is to simplify the administrative procedures and to speed up the issuing of necessary permits for construction and RES utilization. Administrative barriers are among the most serious and ubiquitous barriers, originating from non-aligned regulation, non-defined or overlapping responsibilities, timely procedures, etc. Administrative barriers are different for each type of RES; they can, despite the huge potential, hinder or delay a project development.

Sub-acts should define institutional organization that enables project development based on entrepreneurs' initiatives, including authorization procedures, support system functioning, contracting arrangements, rights and obligations of renewable producers. The whole framework is still pending, and even if adopted, it will take time for new relationships to be established and institutional arrangements to become effective.

3.2. Financial measures

Today, there is no particular financial support for RES development in the Western Balkan countries (except Croatia). Electric Power Utilities, currently monopolies in electricity production and distribution are traditionally not interested in RES. Although it is known that in favourable conditions RES technologies could compete with the fossil fuels technologies in general, reaching the economic level of energy prices of fossil fuels technologies will be very important for the promotion and the increase in use of RES. This process will be highly supported by the participation in the EU integration process, taking into account the EU requirements concerning the necessity of implementation of market economy principles. A prerequisite for sustainable development in the energy sector is the financial viability of the energy companies, so that they have resources to invest in RES, efficiency improvements and environmental protection [27]. This requires the prices to reflect the real production cost and at the same time to protect vulnerable consumer groups through needs-based social assistance programs, instead through subsidized energy prices.

Taking into account the level of economy development, capacity of existing institutions, experiences in energy markets, etc., it is reasonable to assume that the most appropriate support system for RES-E would be price-based principles (feed-in tariffs), due to the simple, transparent and efficient monitoring and management. This system offers flexible approach to implementation and possi-

bility of simple extension of targets, and is in accordance with the Directive 2001/77/EC [27].

The support for renewable heat in the EU has been mainly concentrated on selective, local support policies. Often, these were based on local policy objectives, which combined industrial support or employment opportunities with promotion policies for RES heating. The overviews of heat policies in the EU countries show that the investment incentives and tax exemptions are the main measure for RES heat promotion. Taking into account that RES-H projects are the most convenient for implementation by the local authorities it is necessary to enable local authorities to be owners of all the property. This approach would enable local authorities to provide guarantees for investors and would better motivate them for preparation, development and implementation of RES projects. This is closely connected to local authorities' obligation in preparation of energy development local (municipal) plans as well as local spatial plans.

3.3. Technical measures

A serious lagging in RES application technologies and their implementation is present in many Western Balkan countries. The same applies to the specialized RES equipment producers. Another problem is the shortage of demo and pilot RES facilities and adequate equipment as well as of the modern research and measurement equipment that would enable efficient monitoring of the RES projects and that would contribute to creation of RES database [5].

Technical measures include work on the adoption of the technical norms and rules, and transposition of relevant international standards into national standardization envelope. Necessary standards should cover products, processes and services from the RES domain.

3.4. Measures for education and capacity building

Problem for many Western Balkan countries is the lack of the appropriate organization and internal coordination of RES development with specifically defined responsibilities at all levels. Inappropriate organization and coordination hinder an appropriate exchange of experience in the realization of RES projects (programs) as well as adequate organization of training (education) in the RES field and dissemination of "case studies" and "best practices" in RES development. The RES development is tied to a wide range of new and specific knowledge that has multi-disciplinary character, most often not covered by the traditional educational schemes and not recognized as a research priority. FIf any significant RES development is to be achieved this should be changed thoroughly.

Education of the professional staff is a must for carrying out expert jobs such as certification of products, authorization of renewable generators, monitoring, organization of mechanism for incremental cost distribution, etc.

Realization of these measures by the WBC states and energy companies would establish a convenient environment for a wider RES implementation. Regional collaboration and use of the EU regulations and experiences as a base for the Western Balkans countries' strategies and legislative and economic incentives can be the best way leading to the final success.

4. Conclusion

Renewable energies, based on their availability and absence of negative impact on the human environment, will grow to be an effective and practical choice to guarantee the future development of the world [33–36].

To enhance energy security, countries in the Western Balkan region should make efforts in accordance with the European recommendation that 20% of the energy production should come from renewable energy sources. In other words the significant untapped potential of hydropower (particularly small- to medium-sized HPPs) must be explored, the wind energy potential used, as well as the photovoltaic and biomass possibilities, and solar and geothermal potentials for production of thermal energies too. Many of these can be developed on a commercial basis and used in decentralized ways. Successful development of renewable energy sector in WB requires a combination of political commitment and decision making, as well as supporting mechanisms that would include well-defined government targets, technological advancements, and public acceptance.

The Strategy sets guidelines for energy progress and sustainable development should consist of: improving EE; better use of RES; revitalization of existing and construction of new electro-energy structures; achieving balance between energy development and environmental protection. These should help make the WB countries an internationally interesting RES-E investment challenge.

The identification of country-specific policy recommendation to overcome barriers to investments in energy efficiency and renewable energy are based on the consideration of the country-specific political and economic framework. Strategies, plans and programs include the policy framework that identifies the measures that can cost-effectively yield energy saving or increase renewable energy generation, and assign the responsible institutions in charge of developing, implementing and monitoring the policy framework. The countries in Balkan region introduced the legal framework to promote renewable energy and energy efficiency investments. However, the lack of secondary legislation, enforcement mechanisms and responsibilities for policy implementation or appropriate monitoring, hamper a successful implementation of the policy framework. The need for further incentives to support policy implementation and available resources for incentives and potential funding bodies have to be identified, appropriate types of incentives evaluated and incentive requirements prioritized.

References

[1] The World Bank. Key development data & statistics. Retrieved from The World Bank, World Development Indicators Database; September 2009: http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,contentMDK:20535285~menuPK:1192694~pagePK~64133150~piPK:64133175~theSitePK: 239419,00.html.
[2] International Business and Cooperation, Ministry of Economic Affairs. Croatia, Serbia and Bosnia–Herzegovina – Renewable energy, 80MVK13; 2009. http://www.netherlandsembassy.hr/contents/pages/24320/croatiaserbiaand-bosniaherzegovina-renewableenergy1.pdf.
[3] Papić T, Dragutinović K, Radovanović N. Obnovljivi izvori energije u AP Vojvodini. European business forum on renewable energy sources. In: A conference organised within the "Intelligent Energy – Europe" programme. 2007. p. 43.
[4] Popovski K, Armenski S, Popovska E, Popovska Vasilevska S, Gecevska V. Biomass energy in Macedonia. Skopje: Macedonian Geothermal Association – MAGA; 2010.
[5] Ministry of Economy, Labour and Entrepreneurship. Energy in Croatia: Annual Energy Report, ISSN 1847-0602. Republic of Croatia, Ministry of Economy, Labour and Entrepreneurship; 2008. p. 291.
[6] Golusin M, Tesic Z, Ostojic A. The analysis of the renewable energy production sector in Serbia. Renew Sustain Energy Rev 2010;14(5):1477–83.
[7] RES – Renewable Energy Sources, Final Report, FP6 INCO Project, European Commission, Coordinator: Greece, Partners: Germany, Italy, Macedonia, Serbia and Albania; 2006–2009.
[8] Zhou F. Consideration on China's renewable energy development. Stud Strat Decis 2006;21(4):287–94.
[9] Islami B. Establishment of re fund from "KfW" to support private operation of small hydropower plants in Albania. In: The energy in Albania; 2005. p. 31.
[10] Energy and Environment for Sustainable Development Center. Thematic assessment report under national capacity self assessment project on climate change thematic area. Tirana: Energy and Environment for Sustainable Development Center under the coordination of Klodiana Marika, National Project Manager: outputs of the UNDP-GEF NCSA Project; 2006.
[11] On the basis of Article 16 of Law No. 7491, dated April 29, 1991 "On the main constitutional provisions", by proposal of the Council of Ministers;

2006. Law, No. 7664 dated 21.01.1993 on Environmental protection. Retrieved from Pro.S.Italba: http://www.slas.info/legislazione_albanese/law_7664_1993_environmental_protection.php#top_contenuto.
[12] Štih, K. Obnovljeni obnovljivi izvori energije; 2008. Retrieved from EGE – Energetika, gospodarstvo, ekologija, etika: http://em.com.hr/ege/baza_clanaka.
[13] Annual Energy Report – Croatian Energy Regulatory Agency, Croatia; 2008. p. 105.
[14] Mladineo V. Policy of environmental protection and energy efficiency fund of Republic of Croatia in the field of energy efficiency and usage of renewable energy sources. Zagreb: Environmental Protection and Energy Efficiency Fund; 2009.
[15] Ministry of Environmental Protection, Physical Planning and Construction. Physical Planning System; 2006. Retrieved from: http://www.coe.int/t/dg4/cultureheritage/heritage/cemat/Compendium/PlanningSystemCroate_en.pdf.
[16] Nexus Associates Inc. Evaluation of Southeast Europe Enterprise. Final Report: vol. I; 2003. http://www.ifc.org/ifcext/ieg.nsf/AttachmentsByTitle/SEED_Part1/$FILE/SEED_Report_Volume_I_012705.pdf.
[17] Macedonian National Energetic Strategy, Government of the Republic of Macedonia, Official Gazette; 2009.
[18] Republic of Macedonia, Ministry of Economy. http://www.economy.gov.mk/default-en.asp [accessed 10.03.10].
[19] Energy Agency of the Republic of Macedonia. http://www.ea.gov.mk/cms/index.php?option=com_content&view=article&id=138&Itemid=155 [accessed 10.03.10].
[20] Ministry of Environment and Physical Planning, Government of the Republic of Macedonia. National strategy for clean development mechanism 2008–2012. Retrieved from: http://www.moepp.gov.mk/WBStorage/Files/National%20Strategy%20Kyoto%20Protocol.pdf.
[21] Djajić N. Obnovljivi izvori, stanje i razvoj u Srbiji. Beograd: Grupacija za obnovljive izvore i energetsku efikasnost Privredne komore Srbije; 2008. Retrieved from: http://www.energoportal.info/stranice/obnovljivi%20izvori/OIE%20-%20STANJE%20I%20RAZVOJ.pdf.
[22] Brkić D. Serbian gas sector in the spot light of oil and gas agreement with Russia. Energy Policy 2009;37(5):1925–38.
[23] Kovačević I. Energy efficiency and renewable energy sources projects in Montenegro. In: Regional Energy Security and Energy Efficiency Conference. 2009.
[24] Brečevič D. Energy development strategy of the republic of Montenegro by 2025. Green paper. Ljubljana: Institut za istrazivanja u energetici, ekologiji i tehnologiji; 2007.
[25] Popovski K, Popovska S. Regional development of rural areas through the larger RES integration. Skopje: ICEIRD; 2008.
[26] Rogers JC, Simmons EA, Convery I, Weatherall A. Public perceptions of opportunities for community-based renewable energy projects. Energy Policy 2008;36(11):4217–26.
[27] Luxembourg Office for Official Publications of the European Commission. Sustainable Energy Europe: Continuing the European campaign to raise awareness and change the landscape of energy, 2005–2008. Belgium: European Commission – Directorate General for Energy and Transport; 2006.
[28] Balkan Energy Future. Fossil fuel dependency vs. energy efficiency and renewable energy; 2010. Retrieved from: http://www.bankwatch.org/balkan_energy/.
[29] Renewable development initiative. Albania country profile; 2009. http://ebrdrenewables.com/sites/renew/countries/Albania/profile.aspx [accessed 15.02.10].
[30] Renewable development initiative. Albania country profile: latest developments, projects, policy/regulatory; 2009. http://www.ebrdrenewables.com/sites/renew/countries/Albania/default.aspx [accessed 15.02.10].
[31] Popovski K, Micevski E, Armenski S, Gecevska V, Vasilevska Popovska S. Geothermal energy in Macedonia. Skopje: Macedonian geothermal association; 2010.
[32] Renewable development initiative. Montenegro country profile; 2009. http://ebrdrenewables.com/sites/renew/countries/montenegro/profile.aspx [accessed 16.02.10].
[33] Chen F, Duic N, Alves LM, Carvalhoa M. Renew islands-renewable energy solutions for islands. Renew Sustain Energy Rev 2007;11(8):1888–902.
[34] Hrayshat E. Analysis of renewable energy situation in Jordan. Renew Sustain Energy Rev 2007;11(8):1873–87.
[35] Chen J. China's policy in developing renewable energy. Renew Energy 2003;3:41–2.
[36] Peidong Z, Yanli Y, Jin S, Yonghong Z, Lisheng W, Xinrong L. Opportunities and challenges for renewable energy policy in China. Renew Sustain Energy Rev 2009;13(2):439–49.